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Technical Standards

From The Editor . . .

I get a sense that we are on a long descent into a new dark age, despite the hi-tech world in which we live. We revel in the marvels of new technology, with a total reliance on the electronic world and the new tools and gadgets it brings us that we can't live without. But we forget that is takes a high degree of sophistication, expertise and innovation to achieve these marvels. Education and research, scientific, technical and esoteric arts and philosophy are all part of the foundation on which our new world relies.

Many innovations are the result of enquiring minds, often thinking "out of the box" and pursuing what at first seems like impossible and improbable directions. But they all built up on knowledge from the past, a lot of which is sitting in vaults and seemingly dusty obscure libraries.

There is no guarantee who or when some innovative or curious person will stumble on something that sets them off on a tangent that will lead to the next big idea. And despite the best efforts of the high tech gurus at Google, a lot of knowledge and data from past research is not digitized, nor is it likely that it ever will be. That is why it is so disheartening when we hear of school libraries being closed (many already don't even have librarians), public archives being downsized or made inaccessible, research facilities and their libraries being 'culled' and shuttered, and public discourse being dumbed down to simplistic jargon.

History too often gets overlooked. Yet it tells us of many instances of book burnings, looting and desecration of historically important documents and artefacts. When we look back in time, it's considered ancient history. When we see it happening today, if it's in some far off land, we may see is as another example of uneducated extremists pillaging, but because it's somewhere out there we soon forget about it because we may think there is nothing we can do about it.

The sad fact is it's not just ancient history. Regrettably such activity is happening today right here in Canada, under our noses, with the shuttering of libraries and research labs. Books and documents are being shredded and we are losing something whose value we don't even know. It should be of concern to each and every one of us, whether it's in our area of interest or not. Research reports from projects done one or two or more generations ago can still provide valuable information that can be used to further our understanding today and help resolve today's problems. But those options are being closed to us. And just in case you think it's just something limited to environmental science research, which the current government doesn't seem to want to know about, think again. Even medical research libraries are being closed, or being made difficult to access.

Builders should be concerned as it affects building science research as much as the environmental scientist, biologist or medical researchers. We know that there is much we don't know about the world. We don't know what we don't know.

The improvements in our living conditions, the innovations to come, and the solutions to problems we encounter today will be helped by someone digging into archives, searching for some gem of an idea or information. Whether it's a matter of dealing with proposed code or other regulatory changes, or addressing some new technologies, if we are to avoid foreseeable problems we need to be able to access that information, which may lie in seeming unrelated locations.

It is important to understand much has not been digitized and put on the Internet. And we are now learning that the Internet itself is not as open and accessible as we initially thought as large service providers (and in some parts of the world – governments) are starting to flex their muscle and limit access.

If we don't maintain the body of knowledge built up over time, and allow documents to be trashed and lost, someone will only be recreating the information from scratch sometime in the future when it becomes evident that it's a missing link for some important work. It's as if we're trying to reinvent the wheel.

Richard Kadulski,
Editor

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Technical Standards

In the housing industry, we live by codes and standards. We're familiar with the building code, which sets out requirements for new construction. Even in those areas of the country that do not have a mandated building code, the expectation is that construction will conform to the criteria of the National Building Code.

The building code sets the minimum requirements for a safely built environment. The criteria define the least that can be legally built to produce a building that will be structurally sound under normal conditions, have a measure of fire safety to permit the building to be evacuated quickly before structural collapse, be a healthy indoor environment, and recently, also be reasonably energy efficient. The code itself relies on and references many other standards.

Intuitively we may understand what a standard is, but most of us really don't know technical content of most standards we're expected to comply with. Regrettably, most code users, including most regulators, have never actually read most of the applicable standards. At best we may understand or have a few copies of standards that we are most closely involved with.

A technical standard is a formal document that establishes uniform engineering or technical criteria, methods, processes and practices. A standard may be developed privately by a corporation or industry association or by a regulatory body. However, most are prepared by organizations that are accredited by the Standards Council of Canada which is Canada's national accreditation body that accredits testing and calibration laboratories, inspection bodies and organizations that develop standards based on internationally recognized criteria.

The standard development process is generally open to any interested party to review and comment on proposed standards or changes. Conflicts of interest among the usually voluntary committees developing standards are avoided, and are included in the standards council guidelines. Standards become mandatory when or if adopted by a regulatory authority.

Standards applicable to the construction industry generally cover three broad areas:

Material standards

These deal with the manufacture and design of specific products. This could include the manufacturing process of a product from its raw materials (e.g. gypsum board or masonry block manufacture) or assembly of a product from a variety of products (e.g. window or furnace).

Performance standards

These address the performance characteristics of a product (e.g. energy efficiency of a boiler, or air or vapour permeance of a house wrap product).

Application procedures

These lay out how a product or system is to be installed (e.g. operating conditions and installer qualifications for spray foam insulation installation, or how a window is to be installed.)

Know what it means

Product literature will generally make reference to standards to help users. Especially for new products, it is worth taking a closer look to understand just what those standards mean.

It is also worth mentioning that a CCMC product listing is not the same as a standard. CCMC evaluates product product tests done for manufacturers by independent agencies in accordance with applicable standards. CCMC evaluations, which are posted on their website, provide guidance on how the product complies with code requirements.

International Standards

Many standards are developed by international organizations. Generally, their content will be similar, so it is not possible to say one is better than another, contrary to oft held perceptions. Specifics between countries or standards organizations may vary – more or less, depending on the specific standard and the scope of the standard.

Differences between standards may be accounted for by historical reasons – differences in local customs, practices, and response to local conditions. Sometimes, differences are maintained for subtle, unstated reasons of protecting markets, and are sometimes referred to as 'non-tariff' barriers, although no one will admit it. ✪

Comparing Window Standards

NFRC/CSA (NAFS-08), ISO, and Passive House U-values cannot be compared as they are based on different calculation procedures

Windows are a significant component in buildings. They provide light and ventilation, and are an important building design element. Because windows are transparent, they are also critical to building heat loss and heat gain.

Encouraged largely by vested interests, European products have gained a reputation for high quality. There is a perception that if a product is European it's going to be of high quality. Given the high costs associated with exports, including transport, certification, market development and technical support issues, products seeking an export market, regardless of where they are manufactured and which market they are moving into tend to be focused on the high end, further reinforcing an image of high quality.

Because windows are transparent, they are a complex element to model and evaluate. Windows are a good example of how the various test procedures and standards make it difficult to provide direct comparisons.

With a growing interest in the Passive House standard for energy efficient buildings, European fenestration products are being used more frequently in North American jurisdictions. This has created challenges for building designers and product manufacturers, as the differences between North American, European ISO and Passive House thermal performance rating systems for windows have led to misunderstandings about the appropriate criteria for energy efficient product selection. The same window will have different U-value and solar heat gain ratings under each of these systems, so there is no simple way to compare North American and European product performance.

A recent study by RDH Building Engineering Ltd. looked at various window standards. The objective was to better understand the ISO and Passive House window energy rating systems by comparing them with the North American NFRC/CSA rating system.

In addition to identifying the conceptual differences between the rating systems, the study used computer simulation to see how the differences can result in significantly different product ratings.

Differences between Standards

A review of the various standards identified several key differences between the standards.

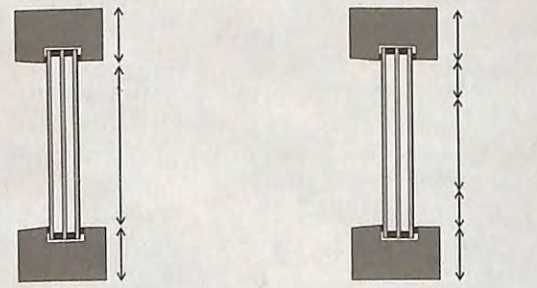
Boundary Conditions

There are significant differences in the boundary conditions used. Each uses different indoor and outdoor temperatures, surface film coefficients, and incident solar radiation values (for solar heat gain calculations). For U-value calculations, NFRC/CSA standards use the lowest exterior temperature, while Passive House certification criteria use an exterior temperature that varies by climate zone. For solar heat gain (SHGC) calculations, NFRC/CSA uses a higher solar radiation value.

Properties Measured

North American rating procedures were designed to compare the relative energy performance of windows under identical size and environmental conditions, and report only whole product values for U-value, Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT) at specified standard sizes. They do not provide values that can easily be extended to products at other sizes or configurations (though frame, edge and centre of glass values are used in the whole product calculation).

By comparison, ISO procedures compare framing systems, spacers, and glass products independently of one another, under different environmental conditions. These are then used in area-weighted calculations to determine window U-values for actual sizes, which can be used in whole building energy modelling.



Passive House: frame and glass area only *NFRC: window frame, edge of glass area, and centre of glass*

Edge Effects Measured

Methods Used to Determine Thermal Performance Properties

NFRC/CSA methods evaluate complete products and generate separate ratings for every combination of frame, spacer, and glass options offered by a manufacturer. ISO methods evaluate frame U-value using a calibration panel of specified conductivity in place of the actual glazing and spacer, then determine an edge-of-glass thermal transmittance value obtained by modelling the actual frame and spacer and subtracting these from the transmittance modelled with a calibration panel.

Centre of glass U-values are also computed differently. NFRC/CSA uses a comprehensive formula to evaluate thermal transmittance across the airspace, while ISO uses a simplified procedure that yields different results.

Reference Sizes for Reporting Whole Product Performance

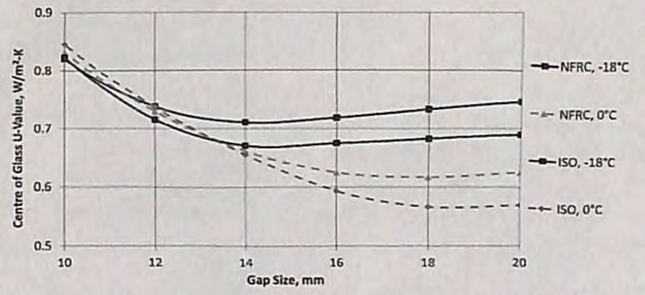
The standard sizes for North American and European windows are slightly different. The ISO standards themselves do not provide standard window sizes but other European rating organizations do have standard sizes. For example, the British Fenestration Rating Council (BFRC) standard size is a coupled window with one opening lite, one fixed lite and a central divider. Passive House products are compared using a single reference size for comparing the performance of windows and another for doors, but requires actual project window sizes to be used for whole building energy modelling.

Skylights

NFRC/CSA simulates skylights and other sloped glazing at an angle of 20° above the horizontal while in ISO standards, skylights are simulated in a vertical position for comparing products, while Passive House certification simulations require roof windows (skylights) to be modelled at a 45° slope. These differences are significant because glass slope reduces window thermal performance. In a sloped window, the heat loss increases due to increased radiant heat loss as well as convective heat transfer between the panes of glass and is therefore an important factor to consider in true thermal performance of a skylight.

Installed Window Energy Performance

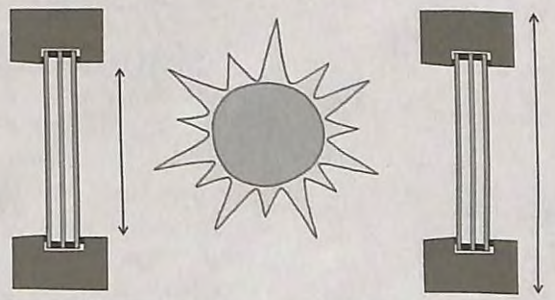
NFRC/CSA methods evaluate the product only. Passive House criteria for windows include both a maximum U-value for the product at the reference size, and a maximum U-value for the installed product that includes the interface with the wall. The thermal transmittance of the window-wall interface is reported as a linear thermal transmittance value, and this value is used with actual project window sizes for whole building energy modelling.



Triple glazing, argon gas fill. two low-e coatings. There is a big difference in derived U-values between NFRC & ISO methods when exterior temperatures are changed.

Solar Heat Gain Calculations

There are two primary differences in the North American and European solar heat gain calculations. The NFRC/CSA Solar Heat Gain Coefficient (SHGC) is for the whole window while the Passive House simulation software requires a center of glass solar heat gain value. This is an important difference to recognize, as center of glass values are higher than whole window values because the opaque frame area reduces solar heat gain in a whole window calculation. The second difference in solar heat gain calculations is the different boundary conditions, including different temperatures and incident solar radiation.



Passive House: centre of glass, not considering frame *NFRC: lower U-value accounts for frame*

Differences: Solar Heat Gains

Methods for Accounting Edge of Glass Effects

The NFRC/CSA calculation methods account for the edge of glass and spacer heat transfer using an edge of glass U-value calculated in a two-dimensional heat transfer simulation program (THERM). The ISO 10077 and related standards use a linear thermal transmittance value to account for this heat transfer.

Calculation of Centre of Glass Heat Transfer

The ISO method uses a simplified calculation procedure with an assumed average temperature difference. The NFRC/CSA method references a different ISO standard that uses a more com-

- All window ratings are not equal. There are significant differences between standards, but neither NFRC nor ISO system is "better".
- Rating programs drive product design - products are optimized to perform best under the rating regimes in effect in Europe and North America.
- European products will soon need to be rated to NFRC/CSA for Canadian code compliance. This is already the case in BC.

prehensive calculation procedure based on heat transfer relationships.

Different Frame Simulations

In the NFRC/CSA procedure, the frame U-value is simulated with the actual window glass in place, while the ISO procedure simulates the frame U-value with a specified conductivity.

Considerations for Designers and Specifiers

The study raises a few important points that designers and specifiers need to be aware of.

It is important to be aware that NFRC/CSA, ISO, and Passive House U-values cannot be compared as they are based on different calculation procedures. When comparing a product from Europe and a product from North America, specifiers should ask for the values in one or the other standard.

When comparing Passive House certified results, a variety of different boundary conditions may have been used in the simulations. When designers are looking for windows for a Passive House certified building, many North American products currently will not match European performance values even when calculated using the same standards due to different product design, particularly different glazing spacing sizes. Gap sizes in North America have been optimized to yield the best NFRC/CSA U-values, and when the same product is modelled using ISO or PHI standards it will not perform as well as a product with larger gap sizes.

It is also important to be aware of different solar heat gain calculations. Passive House solar heat gain values typically refer to a centre of glass value, while the Solar Heat Gain Coefficient (SHGC) that is typically reported for North American products is for the whole window. This study showed whole window values can be up to 50% lower than centre of glass values. Even when comparing centre of glass values from NFRC/CSA and ISO or PHI windows, there are other differences, so these values are not an 'apples to apples' comparison.

Certified U-values are often used for selecting windows and analyzing energy consumption of a building. However, each of the certification programs have strengths and weaknesses, and neither may facilitate optimal window selection for a particular building.

Window frame U-values vary with temperature and surface air films, and thus vary for different climates. NFRC/CSA windows are modelled at an outdoor temperature of -18°C, which is not representative of average winter temperatures in many North American locations, and may be colder than the winter design temperature in many locations. This value is less accurate to use for annual energy modelling and predictions. However, this value is more appropriate for peak design and sizing calculations as it provides a worst case temperature for many locations. On the other hand, the ISO outdoor temperature of 0°C, and the Passive House climate specific outdoor temperatures, may be more accurate for annual energy calculations, but less accurate for peak heating and sizing calculations. Higher outdoor temperatures result in better (lower) window U-values.

There is no easy solution to this issue as consistent conditions are needed for rating and comparing products, but it is useful for designers to be aware that the optimal window for a particular climate may not be indicated by certification U-values from a particular rating system.

The latest edition of the National Building Code references the latest North American window standards. Those jurisdictions that adopt the NBC will require that all products be tested and labelled to NAFS-08, so this may reduce the confusion, but it will be an administrative decision on how closely the authorities having jurisdiction will be looking for those labels. In BC, where the code and new energy standards have been implemented already, this is something the window industry is already facing.

International Window Standards: Review of Energy Rating – International Standards *By RDH Building Engineering Ltd., Vancouver for Homeowner Protection Office. Full report will be available at www.rdhbe.com*
This project was done with the support of: Natural Resources Canada (NRCan); Fenestration Canada; Window and Door Manufacturers Association of BC (WDMA-BC); Glazing Contractors Association of BC (GCABC); Canadian Glass Association (CGA); Association des industries de produits de vitrerie et de fenestration du Québec (AIPVFQ); BC Hydro; Manitoba Hydro; and Hydro-Québec

HRV Performance and Modelling

Heat recovery ventilators are an essential component of energy efficient homes. They allow for effective ventilation with a minimum energy penalty. Continuous ventilation will add to the energy needs of the house, so having an energy efficient HRV with high heat recovery is important.

Efficiency of HRVs is determined based on testing in accordance with *CAN/CSA C439, Standard Laboratory Methods of Test for Rating the Performance of Heat/Energy-Recovery Ventilators*. Testing is done by an HVI-designated laboratory, and product performance ratings are available online at *www.hvicertified.org* in the HVI Directory. The data is intended for the ventilation designer, contractor and purchaser of HRV/ERV equipment. Government and utility programs may also refer to these certified ratings.

Energy performance is measured at two supply air temperature points: 0°C and -25°C.

Two sets of numbers are determined. The *Apparent Sensible Effectiveness* is essentially a measure of the temperature difference of the two airstreams. This is useful to predict final delivered air temperature at a given flow rate and should be used for energy modelling when wattage for air movement is separately accounted for in the energy model.

The *Sensible Recovery Efficiency* is essentially a measure of the energy recovery of the unit, taking into account electricity consumption, heat loss or gain of the unit itself, air leakage, and the energy used for defrost. This value is used to predict and compare heating season performance of the HRV.

Recently Zehnder, a Swiss manufacturer of heating, cooling, and ventilation equipment, has begun to market their HRVs in North America. Their products are touted as the most efficient on the market, and are certified by the Passive House Institute. However, while they are tested by HVI, they opted to test the performance only at 0°C, and not the -25°C point. This may be because they are designed with preheaters for incoming air, so there should be no need for defrost. As a result, since energy use for defrost is not considered, it leaves the impression that the unit is much better than other equipment on the market, while at the same time making a fair energy efficiency comparison impossible.

This is another case where it is important to understand what a standard sets out, and what testing, even when in accordance with a standard, tells us.

For EnerGuide and R-2000 (2012) modelling in HOT2000, which uses data points at 0°C and -25°C for performance calculations, it means that evaluators must use the HOT2000 default HRV values for the -25°C point (which is not favourable for the Zehnder). The current version of ENERGY STAR v.12.1 requires testing to -25°C so that these units are not acceptable, and the next version of R-2000 (2014) Standard due to be published later this year will also disqualify the Zehnder HRV for use in these programs until such time as test data at -25°C is available.

Air Cleaning Drywall: AirRenew®

Certainteed, the building materials manufacturer has launched AirRenew®, a gypsum board product that is specially designed to enhance the air quality of interior environments. It permanently reduces VOCs, particularly formaldehyde in the air, by taking the VOCs out of the air and converts them into safe inert compounds. Once they are captured in the board, they cannot be released back into the air.

The claim is that, based on tests and analysis, it will keep working for up to 75 years. The product absorbs formaldehyde after being painted with water based acrylic (latex) and epoxy paints or covered with breathable wallpaper.

The product features uses 100 percent recycled paper that is treated to protect against mold growth, and contains up to 96% recycled gypsum content, depending on location of manufacturing plant.

The New CSA F280 Standard

By Gord Cooke, Building Knowledge Canada

For more than 20 years I have been wondering and asking why, when doing a heat loss or heat gain calculation for a house, designers have been directed not to consider or include the performance of a heat recovery ventilation system.

Similarly it always seemed a bit inadequate to try and describe the likely air tightness of a house with some simple subjective characteristics such as "average" or "very tight", especially when the air leakage component of the final result might be as much as 30 or 40 per cent of the total. The answer is, of course, it was the best we could do with the information available at the time.

Well now I am pleased to report that the updating of the CAN/CSA F280-2012 Standard "*Determining the Required Capacity of Residential Space Heating and Cooling Appliances*" has been completed and formally published. It replaces the 1990 edition.

I think all readers will appreciate that there have been a lot of changes in housing technology over the last 24 years that can now be more accurately reflected in this new standard.

I'd like to highlight some of the key features of the new standard and the impact they will have on the sizing of heating and cooling equipment for Canadian homes.

Undoubtedly the biggest change in the new heat loss/gain calculation is the way air leakage and ventilation is handled. There are four important features to the new standard in this regard:

The calculation method can now accept objective air tightness indicators such as blower door air tightness tests. This will be important in both new and existing homes where energy audits or specific air tightness targets have been verified by site testing.

The interaction between different types of ventilation systems and air leakage is accounted for. For example, a home with an exhaust-only ventilation system creates a slight negative pressure that changes the leakage patterns in a home and the new standard makes allowance for this.

In the old standard, the total heat loss for the building was assigned to individual rooms as a function of the heat loss of that room. In the new standard, recognition of the stack effect (warm air rising) in a home will mean that the assignment of air leakage heat loss will be a function of the floor level of specific rooms. In other words, rooms on the first floor of a home will be assigned a greater portion of the air leakage component.

Finally, the new standard will allow designers to take credit for the impact of heat recovery ventilation devices employed in a home.

These features will be incorporated into a spreadsheet embedded in the new standard. The algorithms in the spreadsheet are based on the Alberta Infiltration Model (AIM-2) which was first used in the HOT2000 program.

A second embedded spreadsheet will be used to update the calculations of heat loss from the foundation of a home. This new foundation approach accepts a greater range of basement configurations and insulation methods now commonly used in new and existing homes. These algorithms use the same BASESIMP model originally developed for use in HOT2000.

Designers will now have a much wider choice of window types to select from, to reflect the significant change in window technologies. Specifically, the U factors and solar heat gain coefficients reported by manufacturers in their code compliant labeling can be directly input into the calculations. This is especially important in new housing where designers are employing much bigger windows than previously thus the summer heat gain from those windows needs to be accounted for more accurately.

The bottom line of the new standard is that it will provide HVAC designers and contractors with a more accurate and repeatable equipment sizing guide. It will take some getting used to, of course, as contractors have to recalibrate their long-standing rules of thumb for sizing. For example, consider the results for a typical new two-storey, 2,450 square foot-home in a town with a winter design temperature of -20°C (Newmarket, ON, Nelson, BC, or Springhill NS.) and a summer design temperature of 31°C (Newmarket, ON, Brandon, MB, Montreal QC). I have assumed that this new house would be an ENERGY STAR qualified home (with a specific air tightness target) and employing a heat recovery ventilator.

	Total Heat Loss BTU/hr	Air leakage component of Heat Loss BTUs/hr	Total Heat Gain BTU/hr
Old CSA F280	57,646	13,685	32,450
New CSA F280	34,665	5,049	26,750

(Excerpts from article published in Mechanical Business; used with permission)

Of course, this is just a quick example and you don't know all the parameters for this house but are you ready to consider a 40,000 BTU furnace for a 2,450 square foot-home? The air leakage component has been shown specifically to demonstrate that the single biggest change (at least for a new home) in the new standard, is the way natural air leakage is handled.

Housing authorities and Building Code officials have started the process of formally recognizing the standard. Ontario has given notice that the new CSA F280-2012 standard will be recognized in the provincial building code Jan 1, 2015. This will enable designers and contractors to use it in new housing applications. Contractors should look forward to this very positive change for our industry. It has been generally accepted that mechanical systems have been oversized for many years and the old standard facilitated that with the conservative calculation approach, specifically to air leakage and ventilation. The new standard employs more objective measures of air tightness, window performance and basement configurations and will empower contractors to rationalize both the size of equipment and distribution systems in both new and existing homes. ☼

One interesting and hotly debated aspect of the new CSA F280 Standard is the clause in the existing standard stating that the "heating system capacity shall not exceed the total building heat loss by more than 40 per cent", has been removed. Not withstanding the concern that inexperienced designers and contractors may feel compelled to add unneeded capacity without this restriction in place, it was felt that greater flexibility in system design was needed to respond to the reality of new homes and the expectations of homeowners.

For example, consider a larger very efficient new home with large areas of glazing on the east and west orientation of the building. A designer may wish to install two HVAC systems – one serving the east side, one serving the west side to react to the intermittent losses and gains from those windows. Combined the capacity of the two systems might exceed the 140 per cent oversizing limit and yet at any point in time only one system may be operating to ensure the proper comfort levels in all parts of the home. It is expected that the new HRAI Digest will provide direction to designers and contractors to ensure appropriate sizing decisions are made. ☼

Vancouver City Building Code Changes

When a city sets out to become the greenest city in the world, is has implications on city staff, residents, businesses, other organizations, and all levels of government to implement the action plan. That is what the City of Vancouver has set out to do.

Vancouver's Greenest City 2020 Action Plan sets out to bring community-based greenhouse gas emissions down to 5% below 1990 levels, even though population has grown by 27% and jobs increased by 18%. Vancouver's electricity is generated in BC, 93% from renewable resources. The city also is developing neighbourhood scale renewable energy projects, and is facilitated by Vancouver's unique Charter governance structure that gives it the authority to implement its own building code.

The ambitious goal the city has set for its building code is to be the "greenest" building code in North America. It will require all buildings built from 2020 on to be carbon neutral in operation, and to reduce energy use and greenhouse gas emissions in existing buildings by 20% from 2007 levels. A significant step in this direction has been taken with recent changes to the Vancouver Building Bylaw. Although it is largely based on the latest BC (and National) Building Codes, they have made some significant unique to Vancouver changes.

For larger buildings (Part 3 of the code) the new energy requirements are compliant with either ASHRAE 90.1-2010 or NECB 2011 subject to minor revisions to ensure consistency between the two standards, and are already in effect.

For one and two-family dwellings, the requirements are supposed to come into effect March 1, 2014, but delays in preparing documentation mean that the effective date will be in early July. Some of the more significant changes include:

- Increased energy efficiency requirements for walls, roofs, windows and skylights. Walls must have an *effective* R-value of 21.86 (RSI 3.85), and roofs must have a nominal R-50.
- More energy efficient hot water tanks (EF >78%), boilers and furnaces (min. AFUE 92%). For domestic hot water the first 9 feet (3 m) of non-recirculating hot water piping leading from both electrically heated and gas heated hot water tanks, and the last 3 feet (1 m) of incoming piping leading to the hot water tank connection, must be insulated. If the hot water piping system is designed to recirculate the water, the whole system must be insulated.
- The city already requires an EnerGuide certificate prior to issuing an occupancy certificate, so every house built over the last four years has been airtightness tested. However, now there is a mandated airtightness level of 3.5 air changes/hour for all houses.
- Require electric vehicle charging outlets in garages
- Gas fireplaces must be sealed combustion, direct vent, with intermittent pilot ignition or on-demand ignition systems that automatically shut off within 7 days of appliance non-use. Open masonry fireplaces and factory-built fireplaces are not permitted.
- A requirement for mandatory HRV has been in place for a number of years, but now the HRV has to be a minimum of 65% efficient, and the system installer has to show they are trained in the installation of HRVs and provide a completed Mechanical Ventilation Checklist to the building inspector.
- In addition, for all buildings, current barriers to the use of rainwater harvesting systems and green roofs have been removed. Sub-metering of natural gas equipment in residential buildings with more than 20 units is required for hot water generated by a central hot water generation system, for natural gas consumption used for air handling systems in common areas, and for natural gas used for domestic hot water in amenity spaces for pools and spas.

Accessibility Requirements (Adaptable Housing)

Recognizing the changing demographics of an aging population, the code also has introduced significant enhanced accessibility requirements. Although many access issues are standard today in multi-family buildings, a number of additional requirements address all dwellings, whether multi-family or single family.

The adaptable housing provisions in the new 2014 Building By-law support the City's goal of an affordable, liveable, and inclusive city. Vancouver now becomes the only city in Canada to mandate adaptable housing requirements for such a broad range of housing types.

All dwellings will have to have lever faucets on all sinks in bathrooms as well as kitchen. In addition, the waste pipe below the kitchen sink will have to be located to allow for future lowering of the kitchen counter.

Walls in the bathrooms will have to be reinforced to allow future installation of grab bars and drains serving a bathtub will have to be sized and positioned to accommodate a future walk-in shower. As well, shower and bath controls will have to be located in an accessible location, free of obstructions, or offset to allow easy access.

All interior doors within a home will have to have a clear opening of at least 32" (800mm) and at least one exterior entry door will have to have a clear opening of at least 34" (865mm). Interior corridors will have to be at least 900mm wide. Stairways in homes will have to be at least 36" (915mm) wide and be provided with an electrical outlet at the top and bottom of the stairs to allow for future installation of a mechanical lift.

Round doorknobs, the common design in North America, will no longer be acceptable as lever handles will now be required on all doors in homes.

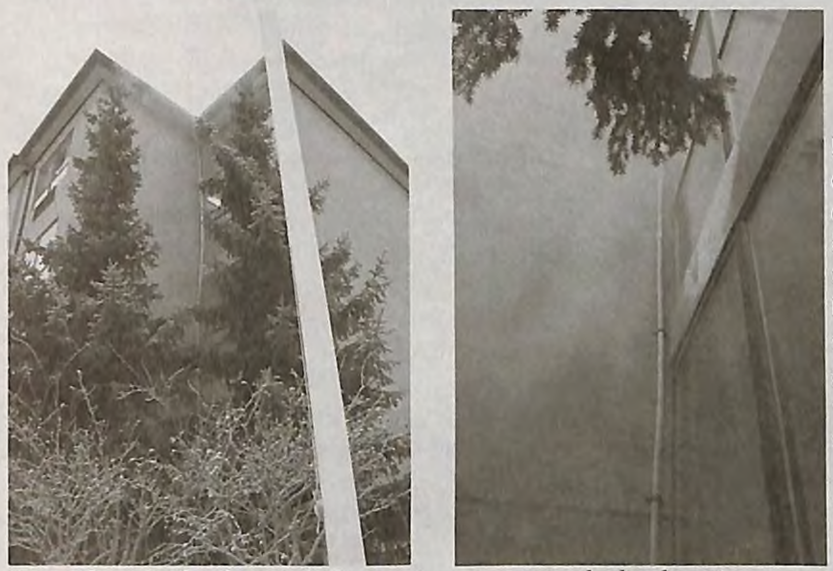
All entry doors will have to be accessible – so that height at the thresholds are not more than 13 mm. Doors serving exterior balconies and basements are exempted from this requirement. This may present challenges for addressing water management issues, especially for doors in exposed locations.

Requirements for Existing Buildings

Vancouver has now introduced mandatory requirements for energy and water efficiency upgrades based on information from an EnerGuide evaluation for all one- and two-family dwelling buildings. The work that must be done is based on the value of the renovation and includes home weatherisation requirements for renovations over $25,000 and minimum added attic insulation where limited attic insulation exists, for renovations over $50,000.

For all other buildings, the level of energy and water efficiency upgrades will be based on the type of work taking place. The level of upgrade for buildings other than one- and two-family dwellings will be graduated, with minimal upgrades for repair type work and more extensive upgrades for major renovations and reconstruction type projects. ☼

Consequences of Sidewall Gas Appliance Venting



From the outside, there is little to raise concern as the landscaping obscures the wall. A closer look, behind the cover of vegetation, shows the plume of condensation and frost on the exterior of the building.

Pictures often tell a story better than words. Recently I had the opportunity to stop overnight at a hotel in Kamloops. The weather was typical winter conditions, with the temperature -10˚C or colder. My attention was drawn to the view through the windows as I was walking down a staircase. The windows were obstructed by condensation – on the outside of the window.

Curiosity got the better of me, and I went outside to look at the source, only to find that the hotel's boiler vent was located on the adjacent wall, near the ground. The exterior cladding of the hotel is EIFS (exterior insulated face-sealed stucco) -- a thin synthetic stucco material applied over expanded polystyrene insulation – a common exterior cladding on commercial buildings. The damage that was caused by the exhaust gases was extreme.

Gas combustion generates moisture, and the moisture plume will rise against the building and can be absorbed by the cladding materials. If there is a vented roof overhang above, the steam can enter the attic where it can be absorbed by the framing. A furnace or boiler has long, if not continuous, run times that can be a problem to the building when vented through the sidewall.

There is little that maintenance can do when the mechanical designers don't fully appreciate the impact their decisions can have on the building. Direct vent gas fireplace vents are seldom a problem, since they are operated intermittently.

Although the gas code permits high efficiency gas appliances to vent through the sidewall, this can lead to problems and should be avoided. This is an example of the unintended consequences when the principles of the "*house-as-a-system*" are not understood or ignored.

Fortunately, the high efficiency appliances generally use small vents, which can be upsized if needed for extra length, so they can generally be taken up through the roof to vent into the atmosphere, away from the building. But there must be an understanding and willingness to be proactive to address the issue at time of construction. ☼

A close up view of the vent shows extensive damage to the exterior envelope of the building cladding - in this case EIFS.

Energy Answers

Rob Dumont

This last winter we have had several major incidents in Canada and the northern U.S. where homes have lost their heating systems for extended periods. There was a major ice storm in Ontario in December 2013 with 600,000 Ontario Hydro customers losing their electricity. In Toronto alone 300,000 homes lost electricity. In southern Manitoba in late January of this year 4,000 customers lost their natural gas supply when a pipeline ruptured.

How fast will a house cool down in cold weather if the electric power or the heating system won't work?

Stuff happens—ice storms, wind storms, pipeline ruptures, computer glitches. A super-insulated house is one way to reduce the discomfort caused by loss of heating in cold weather.

There is no simple answer to your question. In Saskatoon on January 5 this year, the electricity went off for 5 hours in three neighbourhoods because of a computer glitch at a substation. We lost electric power in our house at a time when the outdoor temperature was - 29ºC.

Losing electricity in winter is an unpleasant experience, particularly when the outdoor temperature is so cold. Over that five-hour period our house fell 2.5 ºC and no harm was done. We weathered the temperature drop using winter coats.A neighbouring house, however, dropped 12 ºC over the same period.

Much more serious problems can occur during power outages.In the ice storm in Ontario back in 1998 about a dozen people died from carbon monoxide poisoning when they used their outdoor barbecues inside their houses. In December 2013, an Ontarian died during the ice storm when he used a portable electrical generator in his attached garage. Carbon monoxide drifted from the garage into the house.

There are seven major factors that determine how rapidly a house will cool when the heating system does not work:

The **outdoor air temperature** is a key factor. The colder the outdoor temperature, the more rapidly the temperature will fall in the house.

Insulation levels and air tightness. A major factor is the levelof insulation in the house. More is better. Our house is super-insulated, with R-60 walls and basement walls, R-80 in the attic, R-35 in the basement floor, and roughly R-5 windows. The house is also well sealed, with an air leakage rate of 0.47 air changes per hour at 50 pascals.

Shape of the house. Our house has a fairly compact shape—a rectangular floor plan with two storeys over a basement. A poor house shape, with a lot of surface area for the volume enclosed, would be a long, narrow trailer or a U-shaped, L shaped or T shaped plan.

Thermal mass. The heat storage capacity of the building materials and furnishings in the house is important. When our house was built in 1992, we had the drywall contractor place all the scrap gypsum board in the hollow stud wall cavities of the interior partitions. We also used hardwood floors rather than wall to wall carpets for most of the floor coverings, and we used ceramic tiles rather than sheet vinyl in the kitchen and main floor hallway. All of these actions served to increase the heat storage capacity of the house compared with conventional houses.

Available sunshine. If the sun is shining and the house has windows designed for passive solar gain, the house temperature will not fall, or will fall more slowly, when the heating system is lost.

Wind speed. Under windy conditions, the house temperature will fall more rapidly, as the air exchange rate will be higher, and heat loss, particularly from the windows will also be higher.

Internal heat gains in the house. If the heating system goes down, but the electricity is still available, heat gains from LAME (Lights, Appliances and Miscellaneous Electricity) will also help reduce the fall in house temperature. The average Canadian house has an internal heat gain of about one kilowatt (3,400 Btu/hour) from LAME. For comparison purposes, our house in Saskatoon has a peak heat loss of 5.5 kilowatts (18,800 Btu/hour). A modest amount of heat is also available from body heat from humans. (A typical adult produces about 100 watts or 340 Btu/hour.)

In 1978, Bob Besant and I, along with some undergraduate students at the University of Saskatchewan, performed cool-down tests on two houses at a time when the outdoor temperature was -25ºC or colder. One of the houses was the Saskatchewan Conservation House in Regina – the inside temperature dropped 2˚C in five hours.

If you would like to know more about the mathematics behind house cooling rates, there is a technical paper entitled "Passive Solar Heating: Results from Two Saskatchewan Residences" which presents cooling data for two super-insulated houses.Send me an e-mail at *robdumont@hotmail.com* if you would like a copy of the paper, which was presented at the Solar Energy Society of Canada Annual Meeting in 1978.☼

Best Practices for Window and Door Replacement in Wood-Frame Buildings

The Home Owner Protection office in BC has published a comprehensive guide that explains best practices for window and door replacement in wood-frame buildings, from single-family homes to multi-unit residential buildings. It's intended to help industry meet consumer expectations, provide quality installations and achieve high performance for all types of window and door replacement projects.

This 315-page guide is a valuable reference tool for construction industry professionals, including builders, replacement contractors, window and door manufacturers and others. It outlines Building Code requirements for replacement and installation procedures, and includes a comprehensive list of installation detailing samples.

The guide was developed in partnership with the Fenestration Association of BC, BC Hydro PowerSmart and the City of Vancouver. It is available only in a downloadable PDF version. Copies are $20 plus tax, and can accessed online: *www.hpo.bc.ca*, look under publications.

There is also a free to Window and Door Replacement as a companion to the industry guide. It was created with consumers in mind, to provide helpful information that homeowners need to know to ensure their window and door replacement projects meet the highest standards.

Staff Changes at CHBA National

Don Johnston, Senior Director, Technology & Policy at the CHBA National office, responsible for handling TRC activities, has retired after twenty years with CHBA. Don was CHBA's voice on numerous industry technical and standards committees. Don was trained as an architect and prior to his work at CHBA he was a research officer with CMHC.

Don's successor will be Gary Sharp. R-2000 builders will recognize the name, as Gary has been CHBA's R-2000 coordinator for the past several years. Earlier in his career he was assistant to Tim Mayo at NRCan for the Advanced Houses initiative of the early 1990s. During its existence, until it was axed by the government, Gary was also a member of CMHC's International Training Team which helped Canadian housing exporters in offshore markets.

Canadian Home Builders' Association

Technical Research Committee News

Wall Thermal Design Calculator

Changes to the building code energy requirements mean that wall insulation requirements are now calling for *effective* R-values, and not simply the nominal R-value of the insulation. These changes have been implemented since thermal bridging through structural elements can be significant.

The Canadian Wood Council has developed a new on-line Wall Thermal Design Calculator. This tool provides designers with prescriptive wall assembly solutions that comply with National Building Code energy efficiency requirements. It is meant to provide enough information that architects, designers, engineers, consultants and contractors can quickly determine suitable wall assemblies for each climate zone in Canada. Although the focus is for compliance with the 2010 National Building Code (NBC) Part 9 and 2011 National Energy Code for Buildings (NECB) for larger buildings, the wall assemblies will be a handy reference for compliance with any building code and enables the designer to choose an effective R-value and optimize building design.

The background work for this tool analysed 156 unique wall systems in 5 representative cities across Canada's climate zones. The user is provided with an analysis of the wall system chosen in terms of effective R-values, an analysis of the wall system that provides a pass, caution or fail based on hygrothermal modeling and an indication of compliance with the Code in terms of the outboard to inboard ratio of insulation. Background notes to help designers are also provided.

The wall thermal design calculator can be accessed through the Canadian Wood Council web site: *www.cwc.ca*. Look under resources.

In Memoriam: Gordon Shields

It is with sadness that we must inform readers that Gordon Shields passed away on January 17, 2014 at the age of 47, after a battle with cancer.

Gordon was a founder, the driving force, and past executive director of the Net Zero Home Coalition. His vision and on-going contributions to the Coalition since its inception in 2003 was a core element to its success.

His passion and vision has inspired many to consider the seemingly crazy notion that net-zero energy housing was possible even in a cold northern country like Canada. The combination of his savvy, strategic analysis, and optimism, together with his warm and engaging personality, propelled the organization from a tenuous idea to an international force that is bringing builders, developers, researchers, regulators, utilities, and policy wonks together to further the movement towards ultra low energy, net-zero building.

Letter to the Editor

Re Editorial (Solplan Review No 173, Sept 2013)

I just about fell off the chair as I read your editorial about Built Green no longer requiring a mandatory builder course for new builders. I am in the process of writing them but am still fuming, having great difficulty keeping the four-letter disparaging adjectives from dominating the prose.

Apparently Built Green is going down a path of diminishing respect. First, there was the elimination of mandatory minimum Energuide ratings for each certification step, and the resulting smoke and mirrors of 3rd party certification. Then cutting out the foundation of a successful program – education. How can a program continue without proper training of new blood – i.e. succession planning? It's simply dumb and dumber.

It seems that Built Green is just becoming a marketing platform for big builders. Tick the boxes and input the results. If there is a conflict with a builder's production program, then change the rules to make it easier rather than have the builder adapt. I like the term 'Greenwashing'.

There is huge competition for 'Green' purchasing dollars. There are too many 'Green' building programs for the consumer to choose from. Home purchasers are confused about which program is better. I would suggest that the program with the greatest flexibility, credibility, and stewardship for the future will be the one that will succeed. Built Green, by removing the mandatory builder course, has thrown out the substance of credibility and stewardship.

The next question is at what point does Built Green drop to a level where someone with knowledge pops the balloon of credibility to the media? Or worse, where builders start making serious mistakes in the *'House-as-a-System'* approach creating structural or air quality failures due to lack of knowledge.

I am a builder, and had high hopes for Built Green evolving to a higher level with industry experience and success instead of going the other way. It has all the right elements but seems to be losing the vision. It seems to me like it's a good time to consider avoiding wrapping my marketing around Built Green. My biggest fear is another program collapse. After 25+ years of holding a torch in my arm it is really tired.

RH, Victoria, BC

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